Forest Insect & Disease Management

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Field Office
Project Report

AERIAL APPLICATION OF CYTHION® LV,

SEVIN® 4 OIL, AND ZECTRAN® CF24

CONTROLS REDHUMPED OAKWORM,

Symmerista canicosta Francl.

By Imants Millers, Entomologist, Portsmouth Field Office, Northeastern Area, State and Private Forestry, Forest Service, U.S. Department of Agriculture, August 1980.

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PESTICIDE WARNING

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AERIAL APPLICATION OF CYTHION® LV, SEVIN® 4 OIL, AND ZECTRAN® CF24 CONTROLS REDHUMPED OAKWORM, *Symmerista canicosta* Francl.

By Imants Millers

ABSTRACT

Good control of redhumped oakworm caterpillars, *Symmerista canicosta* Francl., was achieved with helicopter applications of Cythion® LV, Sevin® 4 Oil, and Zectran® CF24.[1] Resmethrin® SBP 1382 did not appear to provide adequate protection. The application rates were:

Cythion LV, commercial grade, 12 fl oz/acre
Sevin 4 Oil, commercial grade, 32 fl oz/acre
Zectran CF24, diluted in No. 2 fuel oil to give 0.15 lb ai[2] per gal/acre
Resmethrin SBP1382, diluted in No. 2 fuel oil to give 0.02 lb ai per gal/acre

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2/ Active ingredient.

INTRODUCTION

About once in a decade, oak stands in the western part of southern Michigan are heavily defoliated by the redhumped oakworm, Symmerista canicosta Francl. Outbreaks last about 3 years and then collapse as suddenly as they appear. The oakworm feeds on most species of oak growing in the Midwest. It is considered a pest only in areas visited by people. The oakworms cause nuisance to people by their presence and activities, and by defoliating trees, which reduces the shade around campgrounds and cottages.

In 1972, the oakworm defoliated more than half a million acres. About 10,000 acres were sprayed by private landowners to protect their homes and businesses. Sevin in water was the only material used, though several others were recommended by the Michigan Agricultural Extension Service. No insecticides were registered for oakworm control with the U.S. Environmental Protection Agency (EPA).

In the laboratory, several insecticides were found effective against the oakworm (Robertson et al. 1972). This report presents the results of field applications of several recommended materials.

The pilot control project was conducted in 1973 when the author was an entomologist at the St. Paul Field Office, Northeastern Area, State and Private Forestry. It was done in cooperation with Dr. W. Wallner, at that time with Michigan State University, and now with the Northeastern Forest Experiment Station.

The primary objective of the pilot control project was to determine the efficacy of several promising insecticides against redhumped oakworm when aerially applied.

METHODS

Test area

The spray areas were located in the Udell Hills area on the Manistee National Forest, near Manistee, Michigan. The forest type is predominantly oak with a light scattering of pines. The general topography is flat. The redhumped oakworm population in the general area averaged about 29 caterpillars per cluster of 100 oak leaves.

Treatment blocks

Each of the four insecticide treatments and the check was replicated three times. Each replicate was about 10 acres, rectangular, and about four times longer than wide. The check blocks were on the

periphery of the treatment blocks. The specific insecticide treatments were assigned to blocks at random (Fig. 1).

Samples

Larval populations were sampled on the lower branches within arm's reach of the collector. A sample consisted of an oak branch cluster of about 100 leaves marked for resampling. Each block had 40 pairs of samples, about 50 ft apart, located in the midportion of the treatment area. One branch of a pair required the presence of a larval colony, which was intended to measure oakworm population change. The other branch, marked X, had no larval colony and was intended to measure insecticide knockdown from upper parts of the tree to the lower crowns.

Later observations showed that the selection of the two types of sample branches was a mistake. Apparently, migration from sample branches to X-branches increased with higher population density (Fig. 2), probably because of foliage consumption. Proper adjustments in the analytical methods are presented later.

The average larval population on the samples with colonies was about 48 per branch. About 80 percent were in the III and IV instars. Larval counts in the colonies were estimated to the nearest 10 unless more accurate counts were possible without disturbance and loss of larvae. Prepsray counts were taken 3 days before spraying. Postspray population estimates were 1, 4, and 9 days after spraying.

Two other methods of evaluation were tried. For both, falling larvae were collected in a given area and the surviving population was used as an indicator of control effectiveness. In one method, 10 x 10-ft plastic sheet traps were placed on 2-ft-high stakes. Larvae on the sheets were removed shortly before spraying and 1 day after spraying. On the 16th day after spraying, the sheets were cleaned, the tree crowns above were sprayed with pyrethrin, and the surviving larvae were knocked down and collected on the sheets. In the other method, sticky traps were placed on 2-ft stakes near the sheets. The sticky traps were made of nonabsorbent 12 x 12-inch food container cardboard that was covered with bird tanglefoot. The traps were set out shortly before spraying and replaced at the same time as the sheet traps.

The area of the traps was calculated and the data converted to number of insects per acre. The polyethylene sheet data, including counts of nontarget organisms, were provided by Dr. Wallner.

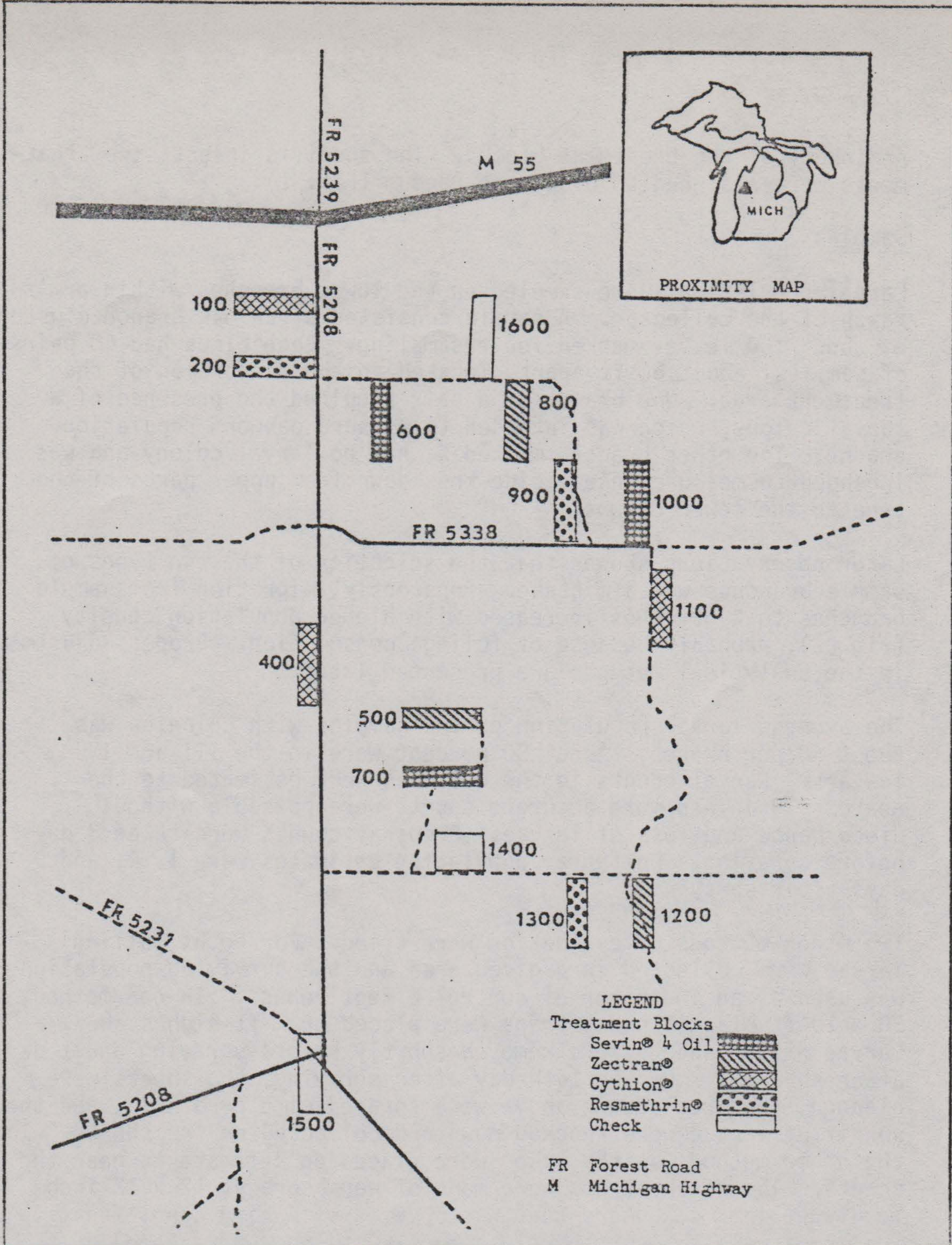

Figure 1. Map of the redhumped oakworm spray area in Michigan.

Insecticides

Cythion LV, commercial grade, was applied at the rate of 12 fl oz/acre (14.4 oz ai malathion).

Sevin 4 Oil, commercial grade, was applied at the rate of 32 fl oz/acre (1 lb ai carbaryl).

Zectran CF24 (1.5 lb mexacarbate/gal) was diluted in No. 2 fuel oil to give 0.15 lb ai/gal, and applied at the rate of 1 gal/acre.

Resmethrin (SBP 1382 by S.B. Penick Co.) was diluted in No. 2 fuel oil to give 0.02 lb/gal concentration, and applied at the rate of 1 gal/acre.

Rhodamine B extra base flourescent red dye was added to all of the insecticides at the rate of 3.8 g/gal of finished spray to increase spray-droplet visibility for deposit assessment.

Insecticide application

The insecticides were applied from a Bell G2A helicopter equipped with electrical pump and standard spray boom. Two Beecomist® spinning screen nozzles were mounted at the end of the boom, one on each side. The nozzles were spun by a 1/4 hp electrical motor supposedly at 8,000 rpm. Sevin 4 Oil, Zectran, and Resmethrin were applied through 100 micron drilled orifice screens. Cythion LV was applied through 40 micron screens.

The insecticides were applied at a height of 50 ft above the tree tops. The helicopter flew at 35 mph, and the swath width was 66 ft. All of the insecticides were applied on the evening of August 11, 1973, except Sevin, which was applied the following morning.

When the evening application began, the air temperature was 72°F and the wind speed was 6 mph. Upon completion, the temperature was 68°F and there was no wind. In the morning, the temperature was 60°F with no wind. The insecticides were applied in the following order: Zectran, Resmethrin, Cythion, and Sevin.

One Cythion treatment block (1100) received poor application because of malfunctioning nozzles. Poor deposit and large drops were found in most of the block. No deposit and no larval mortality were found in sample points 31 to 40. These last nine points were declared unsprayed and removed from the analysis of block averages.

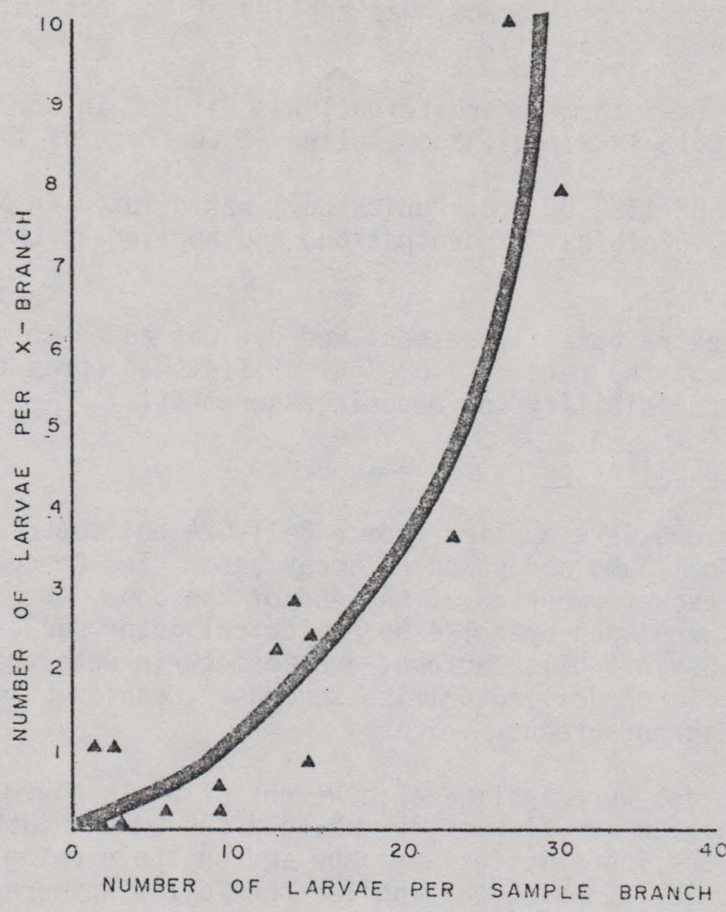

Figure 2. Migration of redhumped oakworm larvae from infested branches to branches (X) with no larvae before spraying, at 9 days after treatment.

The spinning screens slowed down when Sevin 4 Oil (block 600) and Zectran (block 1200) were applied. The spray droplets in these areas were unusually large. One check block (1400) was partially sprayed while the pilot was checking the nozzles for malfunctions. Larval survival here was only about one-half that of the other two check blocks. Therefore, this block was dropped as a check.

The spray deposit was measured on white Kromekote cards placed near the plastic sheet traps. In each area, five pairs of cards were placed on the oak branches. In a pair, one card was placed on top of a leaf on a lower branch while the other was placed on the ground below. In addition, 1/2-inch wide strips were cut from the Kromekote cards, folded lengthwise, and stapled--one on top and one below--a leaf near each card.

Data analysis

Basic summary statistics were used for initial calculations. The original intent was to use infested branch samples only for comparisons. However, because of the extensive migration of larvae to the X-branches and the reevaluation of the implications, all 80 branch samples were combined for analysis.

Postspray larval mortality was determined by comparing the surviving population with the prespray population, and was expressed in percent. Larval survival curves in the unsprayed areas were used to adjust prespray populations in the treatment areas. Percent of control calculations were based on Abbott's (1925) formula.

RESULTS

Within the first day after treatment, blocks treated with Sevin 4 Oil, Zectran CF24, and Cythion LV experienced a population decline in excess of 50 percent. The population reduction was only half that in areas treated with Resmethrin (Fig. 3 and Table 1). Larval mortality among the first three treatments was not significantly different, but all three had significantly higher mortality than the Resmethrin treated and check blocks. The checks had significantly lower mortality than all four insecticide treatments (Keul's test in Snedecor and Cochran 1965 using arc sine square root transformation; at 95 percent level of confidence).

Calculations with Abbott's formula show that mortality caused by the insecticides continued for the 9-day period after treatment (Fig. 4). The percentage of control was 89 percent with Cythion LV; 90 percent with Zectran CF24; and 97 percent with Sevin 4 Oil. Resmethrin SBP-1382 gave only 42 percent control.

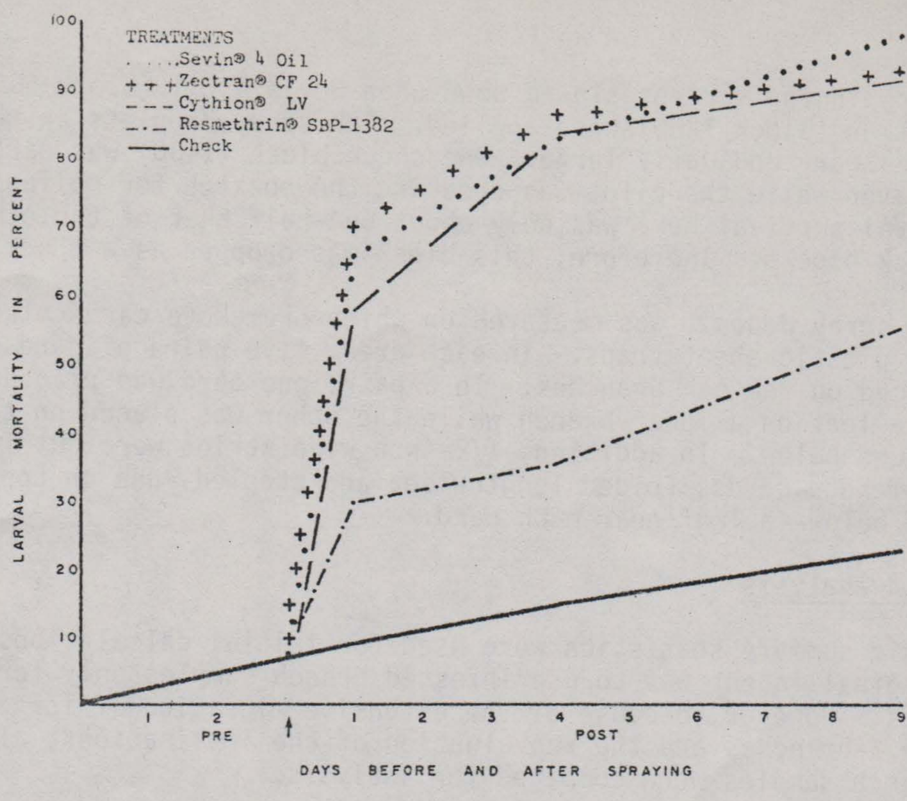

Figure 3. Redhumped oakworm larval mortality during insecticide tests in Michigan.

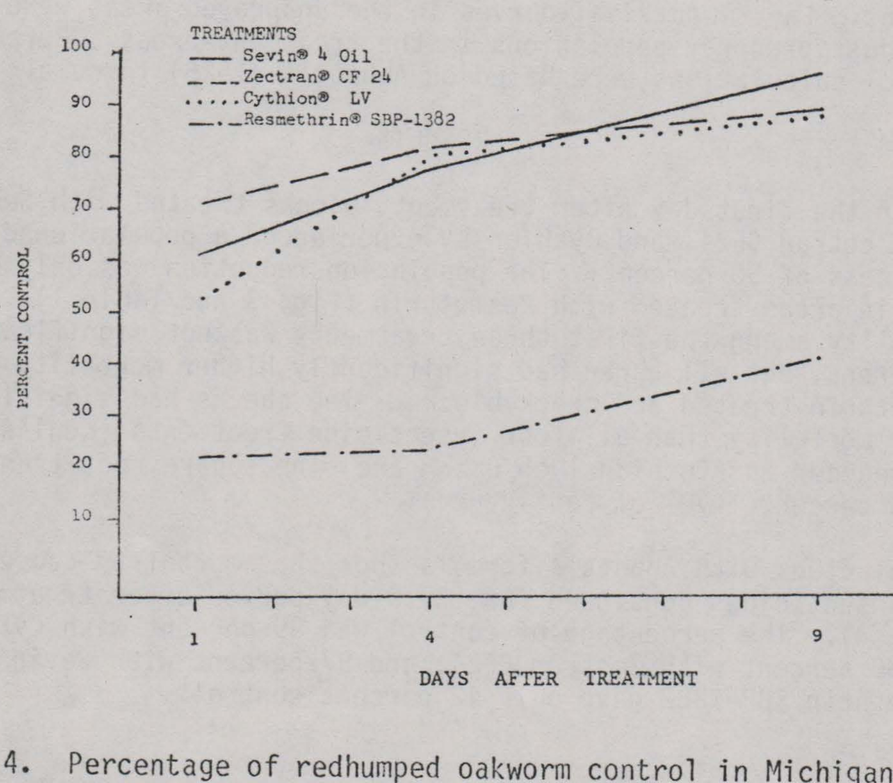

Figure 4. Percentage of redhumped oakworm control in Michigan from aerial application of insecticides.

Table 1. Mortality, survival and control of redhumped oakworm, using sticky traps as indicators.

Treatment	Number of larvae (in thousands)			Percent of larvae	
	Dead		Surviving	Surviving	Controlled
	0-1 days[a]	2-16 days	16th day		
Sevin 4 Oil	389	1363	46	2.6	96.9
Cythion LV	393	330	113	13.5	83.9
Zectran CF24	360	1137	287	16.1	80.8
Resmethrin SBP 1382	134	134	543	67.0	20.2
Check	8	301	1618	84.0	--

a/ Time period after spraying

Data from all the treatment blocks are derived from the sticky trap summaries. Indications were that all the trees above the traps received spray in the insecticide treatment blocks; and none in the checks received spray (except in the block removed from analysis). Several traps were lost because of vandalism. Therefore, statistical analysis of the data did not seem justified.

The sticky trap data show trends of control similar to those for the branch samples (Table 2). If greater care was taken to select blocks with similar population densities, then the final collection after pyrethrin treatment alone may provide adequate evaluation.

The polyethylene sheet traps did not have larval counts from immediate catches because of vandalism. The proportions of sprayed and unsprayed larvae that survived 16 days after treatment are similar to those for the sticky traps (Table 3). As expected, both sticky traps and sheet traps provided adequate evaluation.

The effects of insecticide treatments on nontarget insects were observed on the polyethylene sheet traps (Table 4). The same insecticides effective against the redhumped oakworm larvae were also effective against Heterocampa manteo (Dbldy), the variable oakleaf caterpillar. The numbers of other insects trapped were too low for conclusions to be drawn.

Table 2. Control of redhumped oakworm based on sticky trap counts, by treatment (in percent).

Treatment	Mortality 1-Day	Mortality 16-Day	Effective Control
Sevin 4 Oil	22	98	97
Cythion LV	47	86	83
Zectran CF24	20	84	81
Resmethrin SBP 1382	17	33	20
Check	0.4	16	--

Table 3. Redhumped oakworm populations trapped with polyethylene sheets, by treatment.

TREATMENT	No. larvae/acre after pyrethrin treatment	Percent of control (treatment:check)
Cythion LV	77.5	95
Zectran CF24	95.7	94
Sevin 4 Oil	111.8	93
Resmethrin SBP 1382	394.8	76
Check	1613.0	--

The spray deposit was evaluated in the laboratory under ultraviolet light and with a dissecting microscope. The smallest visible droplet stains were measured at 70 micron diameter. The estimated spread factor for No. 2 fuel oil on white Kromekote® spray cards is 4.5 (Maksymiuk and Moore 1962); thus the smallest droplets measured were 16 microns. The data show a large variation in droplet sizes and frequency between treatments (Table 5). One suspected reason is the jamming of the spinning nozzles.

Small droplets were found on the underside of the narrow strips of Kromekote cards placed above and below leaves. Few droplets were found on the underside of the standard spray cards.

Table 4. Number of insects per acre, by species or groups collected on the plastic sheets during Michigan spray tests (in thousands).

Insects	Carbaryl		Zectran		Malathion		Resmithrin		Check	
	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
S. canicosta	244.7	111.8	298.0	95.7	301.0	77.5	73.8	394.8	41.5	1613.0
H. manteo	28.2	3.6	25.6	20.6	2.3	58.4	12.6	70.7	2.6	40.7
N. gibbosa	3.6	0.1	1.2	0.3	0.4	0.4	1.5	1.0	0.1	0.7
A. senatoria	0.3	0.0	0.1	0.6	0.1	0.1	0.0	0.4	0.0	1.6
Geometridae	0.3	4.5	0.4	0.7	0.1	4.1	1.0	0.9	0.0	0.3
Liparidae	0.3	0.0	0.0	0.4	0.0	0.0	0.0	0.3	0.1	0.0
Phasmatidae	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
D. quercus	0.9	0.0	0.1	0.6	1.7	0.0	0.0	1.5	0.0	3.6
Carabidae	0.3	2.5	0.1	0.3	1.9	0.6	0.0	0.1	0.0	0.4
Tachinidae	0.0	0.0	0.3	0.0	2.2	0.0	0.0	0.0	0.1	0.0
Ichneumonidae	0.0	0.3	2.0	0.0	0.9	0.0	0.3	0.0	0.0	0.0

Table 5. Spray droplet sizes and frequency on spray cards in areas treated in Michigan for redhumped oakworm.

Treatment	Block	Largest diameter (microns)	MND[a] (microns)	No./cm^2
12 fl oz/acre	100	98	36	2.5
40 micron screen	1100	193	56	5.3
(Cythion LV)	400	254	40	10.3
Average[b]		---	43	6.0
32 fl oz/acre	600	123	63	0.5
100 micron screen	1000	277	64	4.3
(Sevin 4 Oil)	700	90	29	1.0
Average		---	52	2.2
128 fl oz/acre	200	207	36	12.1
100 micron screen	900	146	36	8.5
(Zectran and	1300	110	51	7.8
Resmethrin)	500	344	44	2.2
	800	---[c]	--	7.0
	1200	---	--	4.6
Average			42	7.0

a/ Mean number diameter; diameter at which half of the droplets are smaller.
b/ Average, based on droplets from all cards.
c/ Droplet diameters could not be measured because of diffusion of margins.

ACKNOWLEDGMENTS

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LITERATURE CITED

Abbott, W. S.
1925. A method of computing effectiveness of an insecticide. J. Econ. Entomol. 18:256-257.

Maksymiuk, B., and A. D. Moore.
1962. Spread factor variation for oil base aerial sprays. J. Econ. Entomol. 55(5):695-9.

Robertson, J. L., R. L. Lyon, F. L. Shon, and N. L. Gillette.
1972. Contact toxicity of twenty insecticides applied to *Symmerista canicosta*. J. Econ. Entomol. 65(6):1560-2.

Snedecor, G. W., and W. G. Cochran.
1965. Statistical methods. 5th ed. Iowa State Univ. Press, Ames.